HemiStride: Design of a Low-Cost and Backdrivable Lower-Limb Exoskeleton for Hemiplegic Patients

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Hemiplegia is a type of paralysis where one side of the body experiences a loss of motor function. Hemiplegics may be confined to a wheelchair, which presents health issues such as low bone mineral density and muscle atrophy. This project designed and built HemiStride, an affordable single-leg exoskeleton with full gait support for hemiplegics. HemiStride achieves two primary objectives: safety and affordability. Costs are diminished by reducing the power requirements of the joint motors, which is done by minimizing the design scope based on the needs of a hemiplegic patient and incorporating a passive spring actuator that reduces the torque required. The joints were made back drivable by utilizing a gearbox ratio under 40:1, meaning the user can freely move their joints and stabilize themselves during a fall. HemiStride fully powers the hip and knee joint of one leg of a 60 kg subject. The walking motion of the student researcher was tracked using IMU sensors and programmed into the motors. A walking speed of 0.7 m/s was achieved, and peak torque values were measured at 48.2 Nm and 37.1 Nm in the hip and knee, respectively, which were within the previously calculated expected ranges. With its fast-walking speed and weight of 4.5 kg, HemiStride performs equally or better than two-leg exoskeletons currently available on the market. It costs $2,500, a significant improvement compared to the $100,000 that other exoskeletons typically cost. In conclusion, HemiStride has the potential to provide a safe and affordable mobility solution for individuals with hemiplegia.

Awards Won:

Fourth Award of $500